MTM

The Journal of Methods-Time Measurement

MTM ASSOCIATION FOR STANDARDS AND RESEARCH

January
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In This Issue . . .

The Journal of Methods-Time Measurement is dedicated to the technical aspects, application developments and general news items concerning the advancement of MTM.

The Journal encompasses the fields of endeavor that were formerly publicized in the MTM Newsletter and MTM Bulletin.

The technical section of the Journal is concerned chiefly with recent research developments both from the established research program at the University of Michigan, Ann Arbor, Michigan, and from somewhat smaller allied projects being conducted throughout the Association membership.

New applications of MTM as well as refinements of established applications are presented in the Application Section to illustrate specific approaches to management problems that can be solved through the use of Methods-Time Measurement.

Current events in the lives of persons associated with MTM are described in the general news section.

The Editorial Staff welcomes contributions for all three sections described.

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Editor's Note:

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TECHNICAL

MTM RESEARCH ACTIVITIES

David L. Raphael
University of Michigan
Ann Arbor, Michigan

This presentation is an annual report to the users of Methods Time Measurement concerning their continuing and expanding research program. It will attempt to demonstrate to you more than bare factual material, more than disconnected details resulting from statistical and mathematical analyses of motion data. Such information is, of course, extremely important. It is the foundation of MTM's growth and development, the essential ingredient which keeps MTM an improving and ever more efficient work measurement tool. We will bring out such information in this discussion but, in context, displayed to you in a manner which will demonstrate how it solves problems, improves our understanding of the behavior of human motions, and makes possible more accurate and meaningful analyses of complex work elements.

This report will discuss how our present research effort is redefining, expanding and improving our understanding of one of the most complex motion elements, that of Position.

Some time ago, the membership of the MTM Association was canvassed and asked to list those areas of MTM which, in their opinion, most needed investigation and further research. Their replies were of interest, especially in that they consistently chose the element Position to head their respective lists. For various reasons, they found the present MTM application data for Position inadequate for their work measurement needs.

This situation was discussed with several experienced practitioners in order to "pin down" just what the problems and inadequacies seemed to be. By so doing, we hoped to more explicitly define the problems for which our investigations should attempt to find answers. These discussions resulted in a multitude of specific problems, such as the positioning of large as against small size objects and the positioning of objects of greatly differing weights. Though all of these constitute cogent and important questions to which our research would attempt answers, underlying them all we found a more basic fundamental problem. Many practitioners were experiencing great difficulty in applying the Position Data Card Table, as it is now constituted, to many operations. This was especially true in such operations as light assemblies in which Position might make up the major portion of the cycle time. The situation was this: where a finer, more sensitive, breakdown of Positions was needed, the present table was found to be too rough or gross in its subdivisions; where differences in the method of performing the Position were critical (such as the opportunity or lack of opportunity for pre-position), the present table does not discriminate between these differences. The result has been the development of several not too satisfactory "rules of thumb" to help compensate for the weaknesses in the present Data Card Table. In summary, the basic problem seemed to be:

1. If the present data are correct, they still constitute such a rough breakdown of the various positioning movements that it is often difficult to classify a position accurately, i.e., is it a P1SSE, a P2SSE, or somewhere between.

2. The present data are not flexible enough to make possible accurate classification of Positions in terms of differences in the method of performance, i.e., is it a P1NSE, P1SSE (pre-position during move), P1SSE (0" or 1" of engagement).

How our Position research is providing possible answers to this basic problem will be the subject of this discussion.

Now, if the research is to indicate some sort of solution, it must answer certain specific questions. These are:

1. Is the present MTM data accurate as far as it goes?

2. What are the fundamental submotions which make up a Position and how do they behave?

3. What are the methods variations possible in performing a Position and do they affect the time for performance of a Position?

4. Finally, in terms of the answers to the preceding questions, how might we construct a more flexible Position Table allowing more gradations in the classification of a Position and accounting for any meaningful differences in method?

If we can find adequate answers to these four questions, the basic problem in the application of Position in MTM will be solved.

Let us see what answers, therefore, we have found for these questions. The first of them follows naturally from the fact that practitioners have not been able to properly handle Positions in application. The very emergence of the basic application problem just discussed leads directly to the question, "Is the present data actually incorrect, or is it merely that it is not complete or flexible enough in its present form?" Further, the validity of such a question is supported by the fact that in the original research Position data was sparse and confined to only a few of the present classifications. In fact, the present Data Card time values are based on the so-called Theory of Position and have not been verified except by the fact that they have been made to work in application.

In order to answer this question, a sample of more than 250 positions was analyzed. These were collected from a large random selection of industrial operations by means of the familiar film analysis procedure. The film speed was 1,000 frames per minute, which closely approximates the film speed of the original research data. The positions included class 1, loose, and class 2, close, fits; both easy and difficult to handle. There was practically no class 3 fit data and this was not included in the analysis.

The method of analysis was as follows:

1. It was observed that the Data Card Position time values for fit 1 and fit 2, when placed in ascending order and plotted on a time versus rank order graph, fell very close to a straight line. A least-squares regression line was fitted to these time values. This line was taken as the representative trend line for the present Position time data.

2. The research data were broken down into subsamples for each position classification for which there was data. The averages or means for these subsamples were placed in the same order as the Data Card time values and plotted in the same manner as before. A least-squares regression line for the research subsample means was then derived.

3. These two regression lines, the one representing the Data Card and the other representing the research sample data, were compared statistically and graphically.

Exhibit I shows these two regression lines. The positions included range from a P1SE at the lowest point to P2NSD at the highest point. In terms of the normally expected experimental error in our research sample and the fact that the subsamples in the upper range of classifications were quite small, the agreement between the two lines is surprisingly close. In fact, it can be said that, within the limits of experimental error, our research sample, in essence, reproduces the Data Card values. We can infer from this, then, that basically the present Data Card values are correct. At least, this is true as far as they go. We further conclude that what must cause difficulty in application is the absence of a more complete subdivision of positions into finer and more flexible categories rather than any lack of validity of the present data. This answers the first question and we move on to the second.

What are fundamental submotions which make up a position and how do they behave? Our research shows that they follow, in general, those already given in the present definition of the element Position. Exhibit II lists the various positioning submotions.

Here we see that they are divided into two categories determined by the purpose of the motions; transporting motions which get an object to its destination and adjustive motions which insure that the object is correctly seated in or on the destination.

The transporting motion "Move" is not properly a part of what we call "Position" in MTM. It has been included here for obvious descriptive purposes. Our research data has shown that this Move is used to bring the object, in almost all cases, close to the positioning destination, but not directly on it. At this point the movement whose predominant purpose is the actual seating of the object in or on the positioning destination begins. This is the "Engage." It can conveniently be subdivided into two parts:

1. The Primary Engage which brings the object to the surface of the destination, and

2. The Secondary Engage which seats the object in the destination by the actual insertion of the object.

Obviously, if no hole or cut-out exists in the destination, there is no Secondary Engage. In a small number of cases, the Move is performed in such a manner that the object is brought directly to the surface of the destination. In this case, there would be no Primary Engage, though if a hole or cut-out exists, a Secondary Engage may occur.

The Adjustive motions are those already recognized in the MTM Position element. Orient is a rotational movement of the object preparing it for a successful engagement. Of interest is

the fact that it can be performed alone or in combination with Move or the Primary Engage. The research data revealed that it was mostly performed during the Move, where it was limited out; a few times it occurred alone, following the Move and preceding the Engage. Only rarely was it combined with the Primary Engage. Align is a linear movement preparing the object for engagement. Following the Move, it occurred alone or in combination with the Primary Engage. It was not combined with the Orient motion, the two adjustive motions always being performed separately. As is obvious by its definition, neither Orient nor Align could occur during the Secondary Engage.

These, then, are the submotions involved in positioning.

On Exhibit III are listed the submotions which make up a position proper, with the variables which our research analysis has shown have an actual or real effect on their performance. It would be wise to define the variables appearing here, as they differ somewhat from current MTM usage. Symmetry refers to the shape of the object being positioned, the degree of symmetry being determined by the maximum amount of rotation possible in orienting the object for the positioning. For example, an object with a circular cross section would require no rotation, with a rectangular cross section a maximum of 90°, with a trapezoidal, i.e., non-symmetrical, cross section a maximum of 180°. Fit is measured by the tolerance or clearance the object has in being positioned. For example, an object of circular cross section 1 inch in diameter being positioned into a circular hole 1-1/4" in diameter would have a clearance or tolerance of 1/8 inch. Depth is measured in inches and refers to the depth of the hole or cut-out in the destination. Note that no two of these motions is affected by exactly the same variables. Also, the only two which are combined to any degree are Align and Primary Engage.

Let us examine in some detail how each of these motions is affected by its appropriate variables.

Exhibit IV shows the shape or symmetry of the object plotted with the time required to orient the object. As we would expect, the greater the maximum possible orientation (or rotation), the longer the time to orient the object. To relate this curve to more familiar concepts, the 0° point would be the familiar MTM symmetrical, 180° would be the MTM non-symmetrical. The entire range of the curve between these two points is that covered by the MTM classification semi-symmetrical. Specifically, 90° is the rectangle, 45° a square object, 30° a hexagon, and all regular (hence semi-symmetrical) n-gons with more than 6 sides would lie between 0° and 30°. Such a large time range for the semi-symmetrical classification would suggest that a further subdivision for more accuracy might be desirable in an improved Position table, i.e., 4 or 5 symmetries rather than the present 3.

Exhibit V shows the effect of fit and symmetry on the performance time of Align. As we would expect, the tighter the fit (i.e., the smaller the tolerance), the longer it takes to Align the object. However, the time to Align is also related to the shape or symmetry of the object. The less simple or regular the shape of the object, the longer it will take to Align it, no matter what the tolerance or fit. These curves suggest that in setting up a table of Align times it would be necessary to construct a two-way table in terms of both fit and symmetry. These curves also indicate that Align is a much more variable and sensitive motion than it has previously been considered to be. It is certainly more than a constant 5.6 TMU as is given in the Theory of Position now in use.

The Primary Engage time has indicated a slight effect due to changes in fit alone. We will not present a plot of this motion here as it will not be illuminating or necessary. To deal with this motion, a table giving appropriate times on a sufficient number of levels of fit or tolerance is all that would be required. The basic fact is that as the fit becomes more precise, the time for the Primary Engage increases to some degree.

Exhibit VI shows the behavior of Secondary Engage times as we vary the distance of engagement or hole depth. This is shown on three levels of fit indicated by the tolerances associated with each curve. Of interest here is the fact that only with an extremely loose fit do we have the type of behavior that we would expect according to the present MTM picture of the Position Element. The curve for 1/4 inch tolerance is approximately the same as that of Move, Case A, for the distances involved. What seems to happen is that as the path of Secondary Engagement becomes more restricted as the tolerance decreases, the movement became more and more highly controlled. This occurs to a degree far beyond the level of control of Move, Case C. This condition is demonstrated by the middle curve. The upper curve is approaching the condition where there is binding and frictional resistance to engagement. Of importance here is the fact that only with the very loose fits is there only a small effect on performance time as the depth increases. With tighter fits, the Secondary Engage time is seriously affected by increases in the depth. A table of times for Secondary Engage would certainly require a breakdown in terms of several levels of fit and depth if it is to sensitively reflect Secondary Engage behavior in application.

We have spelled out in some detail the behavior of motions which go to make a positioning movement. This quite adequately answers the second question concerning the actual motions involved in performing a position and their behavior in terms of their critical variables.

We now turn to the third question concerning the variations in method employed by an operator in performing a given position. As we have said, the successful completion of a position involves the performance of four basic submotions: Orient, Align, Primary and Secondary Engage. However, they are performed in various combinations and orders determined by the parts being positioned by the particular conditions prevailing in a given operation and by the operator performing the motions. The various methods do follow certain regularities. These are:

1. Orient is not done with Align or Engage but generally precedes them.

2. Align may be done alone or in combination with the Primary Engage.

3. Secondary Engage, of course, is always done alone and follows all the other motions.

In light of these characteristics, four general methods tend to prevail each equally successful and providing a different performance time. The methods are:

1. After the move, the object is oriented, engaged (primary), aligned, engaged (secondary).

2. After the move, the object is oriented, aligned while engaging (primary), the Align limiting out the Primary Engage, and engaged (secondary).

3. The object is oriented during the move, the move limiting out the Orient, engaged (primary), aligned, and engaged (secondary).

4. The object is oriented during the move (Move limiting out the Orient), aligned while engaging (primary), the Align limiting out the Primary Engage, and engaged (secondary).

Each of these four methods, in light of the behavior of the component motions, will result in a different total performance time. Thus, the answer to the third question is precisely that there are several methods of performing a position and that these methods variations will result in different time values.

Thus, the research into Position presents this general picture of the motion element Position.

1. The present MTM data is accurate and reproducible. Because of the way it is presented, it is not amenable to flexible adjustment and modification to fit the multitude different levels of positioning. It provides only a few specific classifications which cover the range of positioning times, but with large uncovered intervals into which many positions actually fall.

2. The sub-motions which make up a position are, in general, quite sensitive in a time sense to changes in the critical variables of fit, symmetry and hole depth. The present Data Card classifications are not sensitive to such changes.

In all, it seems certain by the research results so far that some modification in the Data Card Position Table will be necessary. I should like to demonstrate how a new Position table might be constructed.

Exhibit VII shows a dummy table. It is in four parts, one for each of the basic motions which makes up a position: Orient, Align, Primary Engage and Secondary (Easy to Handle). Each part has an appropriate table of time values broken down in terms of the variables which we know affects them significantly. For convenience we have chosen only 3 fits and 3 symmetries. We could have more of each of these variables if this were warranted. The thing to note about this table is that each section is independent of the others. To determine a time for a position from this table one must:

1. First determine the fit, symmetry and hole depth involved.

2. Second, determine the method of performing the position; that is, which of the four basic sub-motions actually occur as limiting motions.

3. The time value for the position would then be determined by adding the appropriate time values for each of the occurring submotions. The flexibility of this table is much greater than the present data card table.

Exhibit VIII compares the two tables. For a given fit and symmetry, the present MTM table provides one position time. This new table, allowing 4 basic method variations, each with 4 hole depths provides 16 position times for each fit and symmetry. In total, for all fits and symmetries, while the present Data Card provides only 9 position times, this new table will provide 144 position times. This slide demonstrates how the basic problem in Position application discussed earlier can be solved by a Position table which you have just seen. This new table is very flexible in application and provides

a fine coverage of the possible types of position which might occur.

I should like to mention at this point that the position research project is still in process. The material I have presented to you today is still somewhat tentative in nature. It has been presented to demonstrate the direction our research has been taking. We may expect even more definitive information in the future.

EXHIBIT I

REGRESSION LINES—INDUSTRIAL POSITION DATA

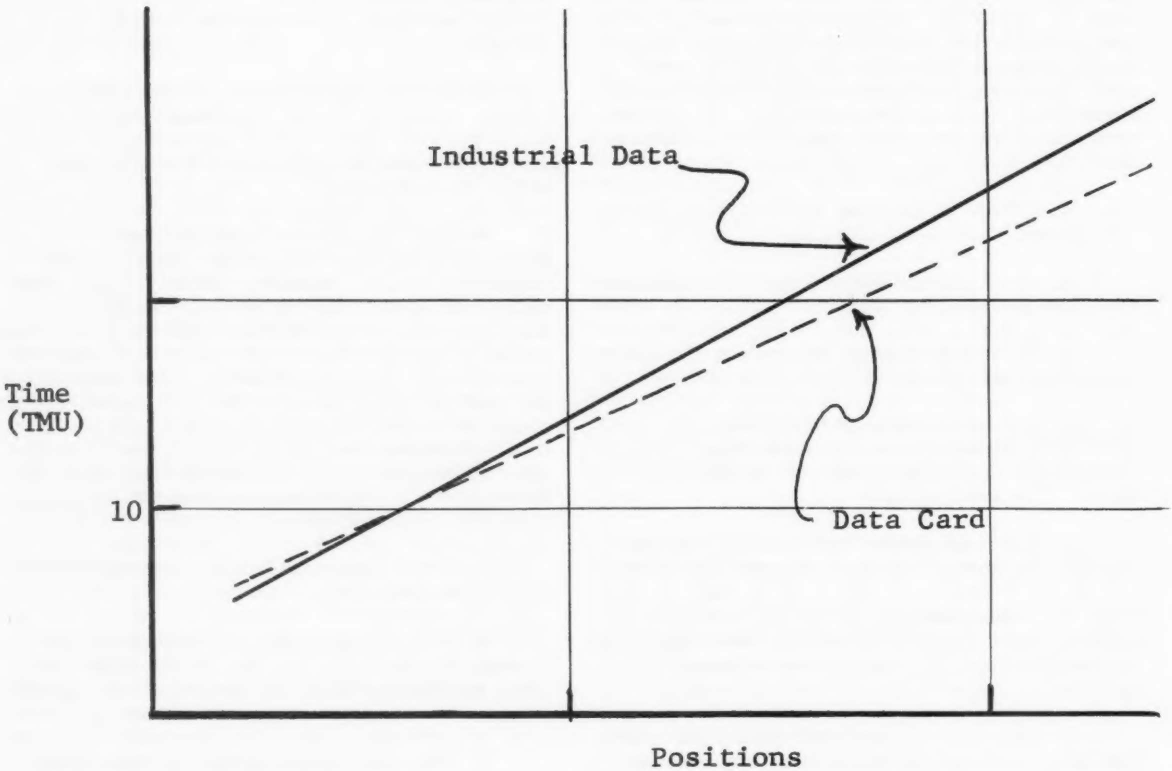


EXHIBIT II

POSITIONING MOTIONS

Transporting Motions—Move (M)

Engage (E)

Primary E_1

Secondary E_2

Adjustive Motions—Orient O

Align A

EXHIBIT III

VARIABLES AFFECTING POSITIONING MOTIONS

Motion	Variables
Orient O	Symmetry
Align A	Fit, Symmetry
Primary Engage E_1	Fit
Secondary Engage E_2	Fit, Depth

EXHIBIT IV

ORIENT–TIME VERSUS MAXIMUM POSSIBLE ORIENTATION

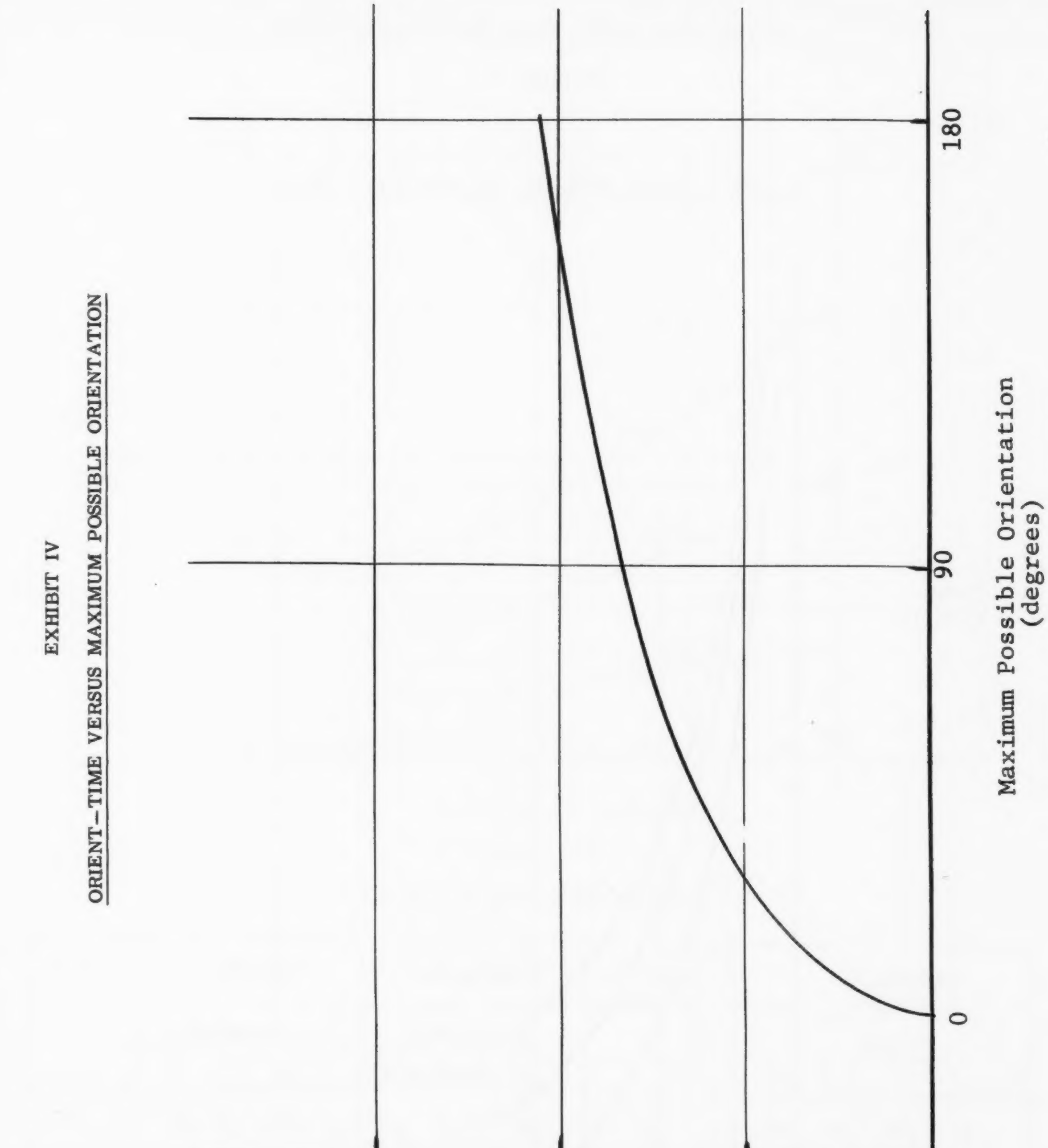


EXHIBIT V

ALIGN - TIME VERSUS TOLERANCE CURVES

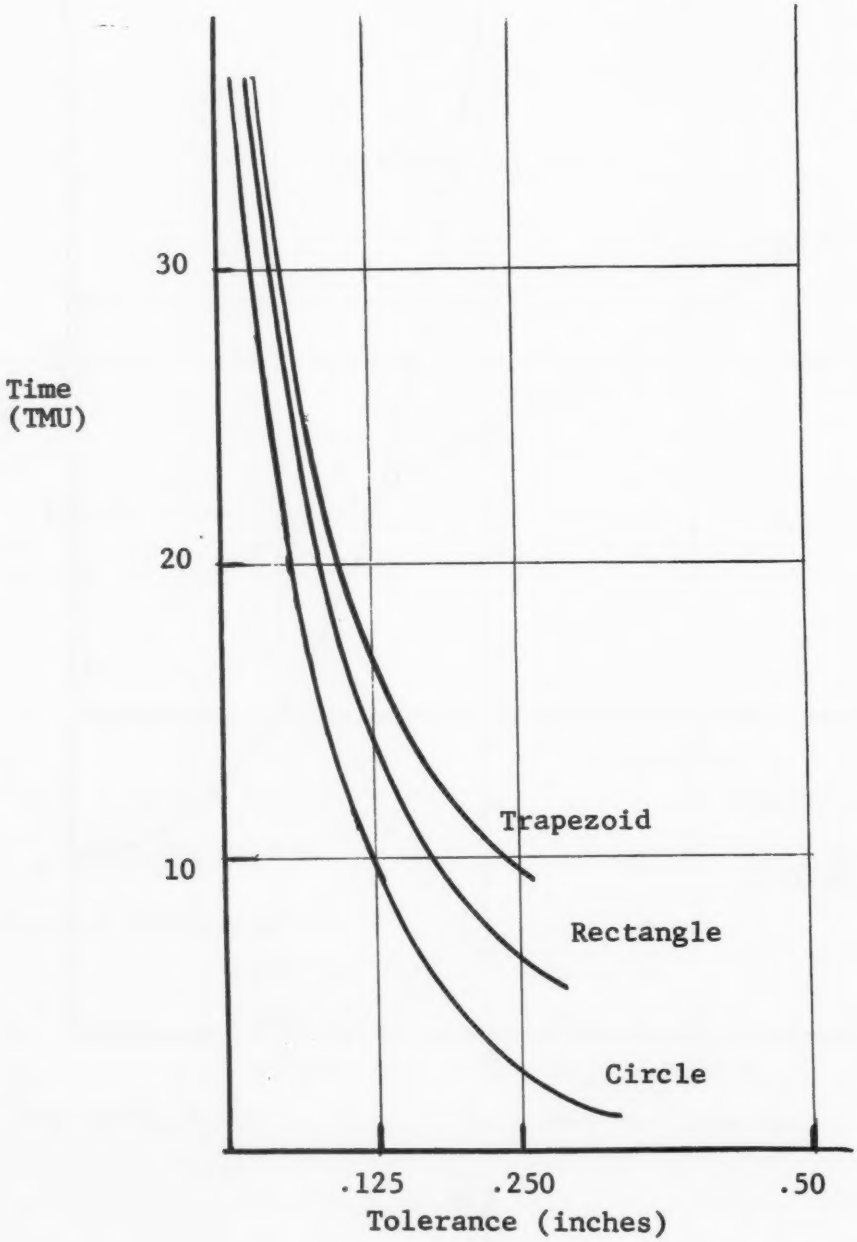


EXHIBIT VI

SECONDARY ENGAGE—TIME VERSUS HOLE DEPTH

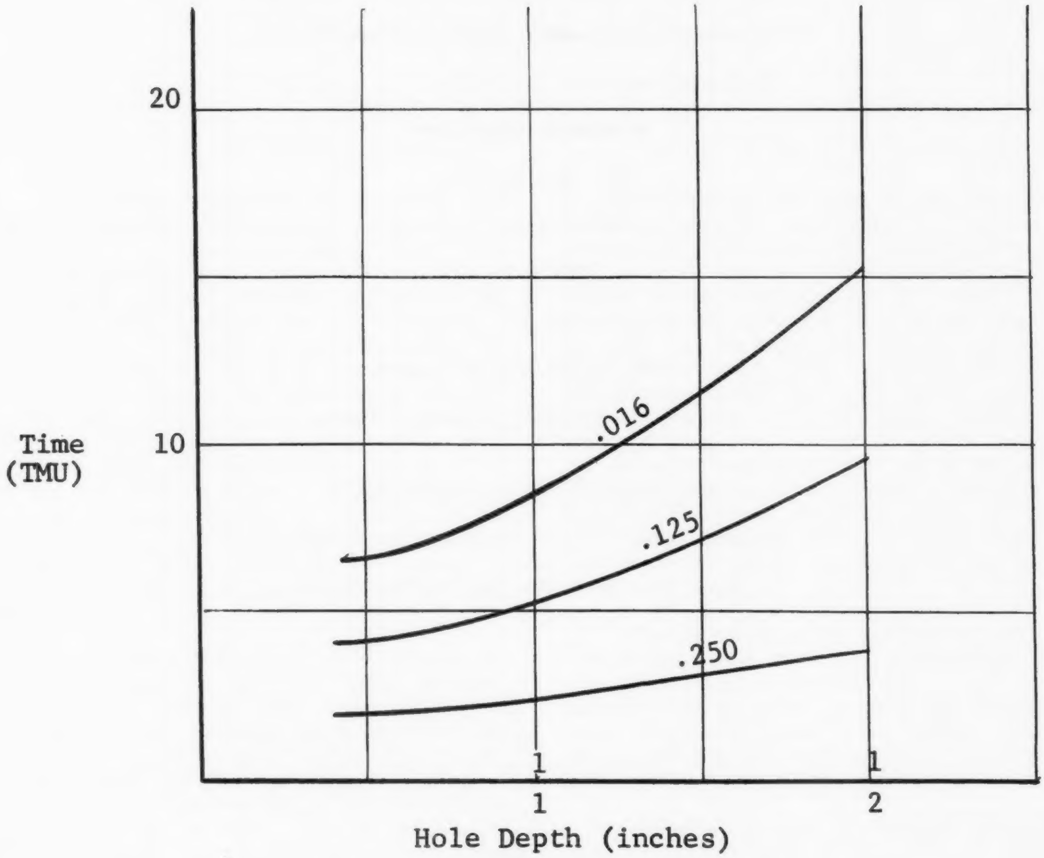


EXHIBIT VII

HYPOTHETICAL POSITION TABLE

FIT	ORIENT Symmetry			ALIGN Symmetry			PRIMARY ENGAGE	SECONDARY ENGAGE Depth			
	S	SS	NS	S	SS	NS		0	1/2	1	1-1/2
1	O_1	O_2	O_3	A_1	A_2	A_3	E_1	F_1	F_2	F_3	F_4
2	O_1	O_2	O_3	A_4	A_5	A_6	E_2	F_5	F_6	F_7	F_8
3	O_1	O_2	O_3	A_7	A_8	A_9	E_3	F_9	F_{10}	F_{11}	F_{12}

EXHIBIT VIII

FOR A GIVEN FIT AND SYMMETRY

Present Data Provides 1 Position Time

Proposed Data:

4 Methods Variations

$O + A + E_1 + E_2$

$O + A + E_2$

$A + E_1 + E_2$

$A + E_2$

Each with 4 Hole Depths

Provides 16 Position Times

FOR ALL FITS AND SYMMETRIES

Present Data Provides 9 Position Times

Proposed Data Provides 144 Position Times

APPLICATION I

MTM STANDARDS FOR "JOB SHOP" OPERATIONS

Ronald C. Auld
Chicago Lighthouse for the Blind
Chicago, Illinois

The Chicago Lighthouse for the Blind is a private, non-profit, philanthropic organization dedicated to provide opportunities to blind people to use and develop their abilities. To accomplish this we have a three-fold program—social service, a training course and our workshop. The workshop, in terms of space occupied, is our largest function, but by no means an end in itself. An average of 150 blind people are employed. Blind people as employees are no different than the people you have in your shops. Some are ambitious, some lazy, some good workers and some poor workers, but they do have the additional handicap of blindness. You may know that about 60% of all legally blind people have some degree of vision. We roughly classify them in two groups—partially blind and totally blind.

To provide jobs for our employees we do sub-contract work in packaging, light machine operations and hand assembly. For the Western Electric Company we assemble switchboard jacks, some types with 41 parts. One of our largest contracts, with the Skil-Craft Corporation, is the packaging of a complete line of toy chemistry, microscope and tool sets. The sub-assemblies for this contract include riveting of saws, filling and labeling bottles and vials, and many other small hand assemblies. For Hotpoint Company we assemble terminal blocks for electric ranges. This is set up on a line assembly with three hand operations and two different types of semi-automatic screw-driver operations. We have a wide variety of other types of work including tag-stringing and gathering of screws into envelopes.

Our work is solicited from private industry on a basis of competitive merit. We ask no favors on price, quality or delivery schedules. Our competition is any firm doing the same type of work. We are a job shop without a specialty. The types of work are widely diversified. This is desirable because of the variety of training available since most of our employees are with us for this purpose. From an operating standpoint, however, the diversity of work is a problem.

Our workshop is operated under a special certificate issued yearly by the U.S. Department of Labor. The certificate requires that our rate of pay be equal to that paid by any other firm for a like quantity and quality of work, but we are exempt from paying the hourly minimum. For example, assume that a non-handicapped worker earns $1 an hour for 100 units. If one of our workers produces 80 units per hour we pay 80¢, or one cent each. The same unit cost but a lesser hourly rate. Our average rate of pay to blind people last year was 86¢ per hour with a minimum of 50¢ per hour. This may sound like an advantage but consider the fact that we are a training shop, that our better workers leave for jobs in private industry and that extended training and supervision time all add to our costs. None of this can be passed on to our customers and have our prices remain competitive.

One of our greatest needs therefore is to determine: What is normal production? Our records do not provide this information as we are not employing non-handicapped, trained workers. We cannot expect a prospective customer to provide the information—many do not know, still others would prefer not to tell us.

Prior to our use of MTM we depended on time study and found it most difficult when only one sample of a job was available. Our records on past performance left us vulnerable as our standards on work efficiency were quite uncertain and usually we did not have comparable work. We have been using MTM for the past two years and feel we now have a sound basis on which to build our price quotations. During the past year a prospective customer made claims of production time that we felt was excessively fast. This was done, we felt, to convince us that our price was too high. Using MTM we were able to disprove the claim and effectively substantiate our price, thus eliminating what could have resulted in a substantial loss to the Lighthouse. More important, we feel we now have accurate standards to use in measuring the progress of our blind people in training.

We know, of course, we have made mistakes with MTM and hope we have learned from the experience. The procedure we use in figuring a price does not vary greatly from that used by any other firm. We obtain a sample of the job if available and first discuss possible methods

of production. We then proceed to set up a work place, either in our shop or a mock-up at a desk, whichever seems most practical. We have begun to establish standard bin arrangements for which we have determined average distances for reaches and moves. For some time now we have been compiling data on packaging screws into envelopes and will ultimately have standard data for this type of work.

Our MTM analyses are all based on the motions required by a normally sighted person to perform the operation. The resultant leveled time, plus P. F. & D. allowance, is the basic direct labor time used for estimating purposes. To this we apply the going wage rate for similar work, our overhead, and other applicable expenses. The price quotation is then calculated by the unit.

If and when we receive the job we re-examine our original analysis to determine if there are any changes in methods due to product changes. We make no change to compensate for blind workers. <u>Our standards then are issued on the basis of performance by a sighted worker</u>.

By now I feel sure you are thinking, "How can a blind worker be expected to attain the production of a sighted worker, and how can rates be established for a blind worker on an analysis prepared for a sighted worker?"

We believe that, though the motion pattern will vary considerably, the total time difference is of no major consequence. I'd like to qualify that by saying, however, that we realize that a blind person cannot efficiently do every job. We do employ some people with normal vision for specific jobs. For example, visual inspection of parts. The number employed is less than 5% of our total shop employees. Also, if from our experience we believe a job would require a high percentage of sighted workers, we may refuse to accept the job.

I do not wish to create the impression that we can substantiate, with facts, that all of our assumptions are correct. However, through observation of many workers, many analyses, some frame by frame study of film, we have developed some theories and opinions. If you will turn to the MTM Analysis among the sheets given you, I'll show, as best I can, some of our reasoning. (See Exhibits I, II, III.)

The analysis covers the assembly of a rubber washer to a brass bolt. We devised a simple fixture consisting of a hollow post mounted at a convenient work angle. The post has a spring inside to eject the part after it is assembled. The work place layout is shown on the reverse side of the first sheet. On the front of the sheet we have shown a comparison of the assembly operation as performed by a sighted person and by a blind person. It would take .3 TMU's longer for the blind person—less than one-half of one percent of the total time.

Turn now to the element analysis on the second sheet. At the top you will find the motions used by a sighted person, below are the motions used by a blind person. I will talk about the motions used by a blind person and make comparisons as we go along.

The first motion is a R9A with both hands to the pans of parts. The surface of the parts becomes a fixed location to a blind person.

Following this an M2A with both hands. There is no selection, just a closing of the hands gathering the parts between the fingers. Several re-grasps are then made—first with one hand, then the other, to retain only one part. We assume in this case that they cannot be performed simultaneously because of the mental control required. From cycle to cycle the re-grasps may vary from none at all to three or four, depending on the type of part and the skill of the operator.

With the left hand, still in the first element, we have an R9A, limited out by the re-grasps of the right hand picking up the bolt. Actually, the left hand is carrying a part, but mentally the operator is reaching for the post of the fixture. Here we feel the intent changes what would be a "C" move for a sighted person, to a reach to an object in a fixed location. We find a similar occurrence in moving two parts to the pilot of a riveting machine.

The left hand then grasps the post as the right hand brings the bolt to it. The right-hand motion is classified as an M9A. The blind person is actually placing the bolt between the fingers of his left hand. Then, he makes a fractional "C" move to the washer. We call this a "C" because of the control required.

Following this a P1SE with each hand, aligning the bolt to the washer and the washer to the post. An AP1 with the right hand, and a release with both, complete the assembly. The spring ejects and disposes of the part. This analysis is of a motion pattern used by a totally blind person and is typical.

The remaining sheet you have is a simple graph showing the result of one complete job in our shop. It was the packaging of a five-piece coaster set into a chipboard sleeve. 200,000 sets were produced over 26 working days with an average of six operators.

The solid line shows the group average.

The dotted line is the average production of two totally blind people whom we considered better than average employees in our shop and who, according to our standards, were about ready for placement in private industry.

Notice the low production at the beginning of the job. We did not approach 100% until the ninth day. Unfortunately, this is typical of blind workers. To compensate for lack of vision a blind person must acquire a mental picture and muscular memory, of the various lengths of reaches and moves in order to develop an efficient work pattern. Because of this our training period on most jobs is longer than that required for a sighted person.

The sharp drop in the center of the graph was a period of partial days' production, due to a shortage of material. We do not feel this drop is significant as there was undoubtedly enough lost time in switching from one job to another to account for it.

MTM ELEMENT ANALYSIS SUMMARY

File EXHIBIT I
Page 1 of 2

Chicago Lighthouse
Part Name Bolt and Washer Assembly Part No.
Oper. Name Assemble Oper. No.
Machine Mach. No.

Department 3rd Floor Analyst RA Date Approved Date
Material Brass Bolt, Rubber Washer

Tools Fixture with Spring for Ejecting Assembly
3 #57 Ecko Bread Pans 6½" x 10½" x 3"

Material Handling Operator Stocks Parts in Pans and Dumps Finished Assemblies in Barrel

Quality Washer Must Be Firmly Seated Against Head of Bolt

Safety

Remarks Actual Production 9200 to 9700 Per 8 Hours
Lighthouse MTM Standard 75-6 TMU + 20% = .907 Hrs/M
51.9 TMU/Cycle on Picture

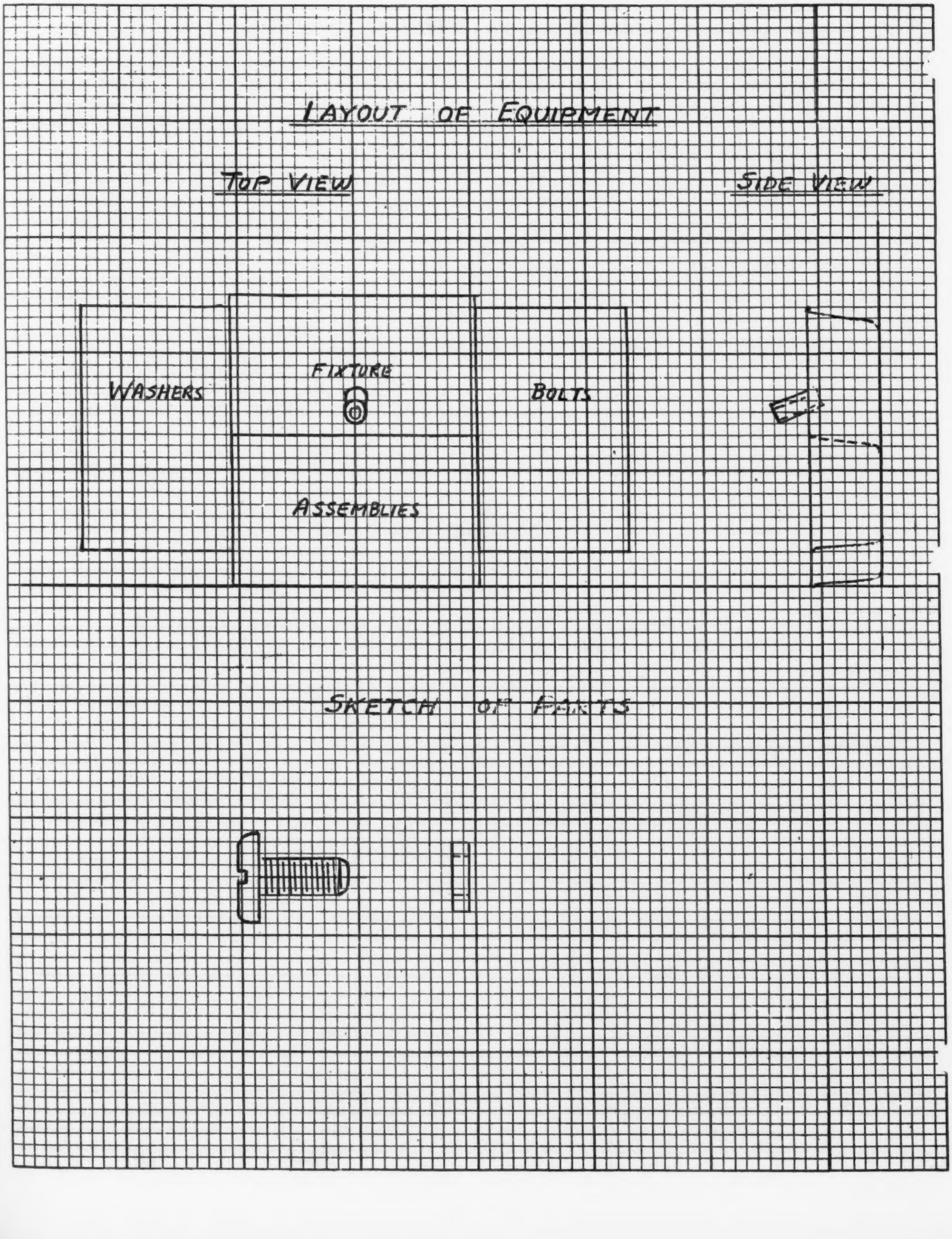
No.	ELEMENT DESCRIPTION	Time TMU	Occurrence Per Cycle	Total Per Cycle
	Sighted Person			
1	Place Washer on Fixture and Pick Up Bolt			48.7
2	Assemble Bolt and Washer and Release			27.2
	Total TMU			75.9
	Blind Person			
1	Place Washer on Fixture and Pick Up Bolt			34.3
2	Assemble Bolt and Washer and Release			41.9
	Total TMU			76.2

Total TMU Per Cycle
Allowances %
Allowed Hours Per
Pieces Per Hour

Sheet Of

EXHIBIT I
Page 2 of 2

SKETCH OF WORK PLACE, PARTS, TOOLS, ETC. WITH DIMENSIONS



MTM ELEMENT ANALYSIS

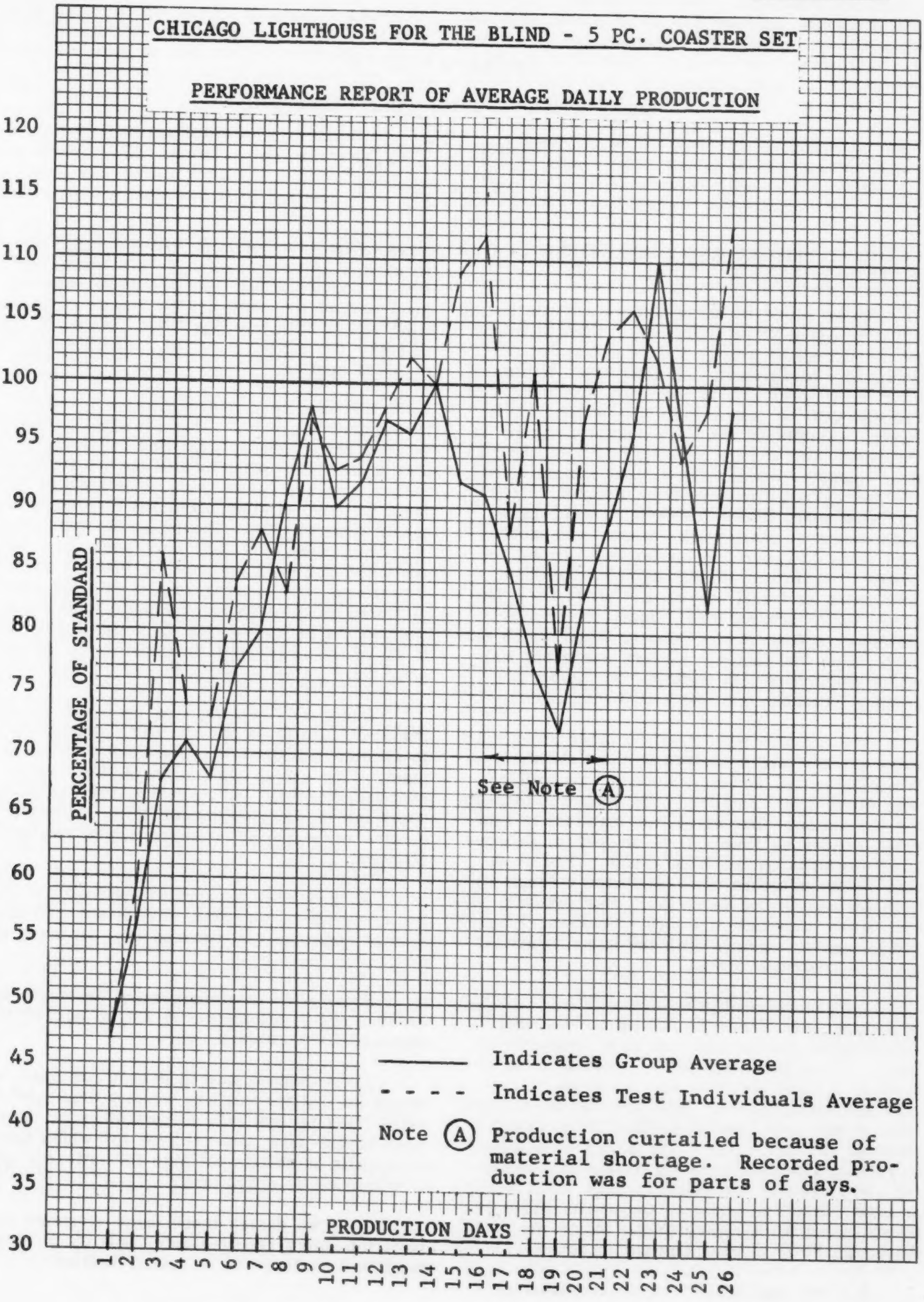
File EXHIBIT II

Part Name Bolt and Washer Assembly Part No.
Oper. Name Assemble Oper. No.
Operator No. Analyst Date

DESCRIPTION - LEFT HAND	F	MOTION	THU	MOTION	F	DESCRIPTION - RIGHT HAND
		Sighted People				
1. Place Washer on Fixture and Pick Up Bolt						
to Washer		R9C	12.2	R9C		to Bolt
Washer		G4B	9.1			
			9.1	G4B		Bolt
to Fixture		M9C	12.7	M8B		toward Fixture
		G2	-			
on Fixture		P1SE	5.6			
			48.7			
2. Assemble Bolt and Washer and Release						
		Hold	3.4	M1C		to Washer and Fixture
			5.6	P1SE		
			16.2	AP1		Push thru Washer
Washer		RL1	2.0	RL1		Bolt
			27.2			
		Blind People				
1. Place Washer on Fixture and Pick Up Bolt						
to Washers		R9A	8.3	R9A		to Bolts
		G5	0.0	G5		
Gather Several		M2A	3.6	M2A		Gather Several
Select One	2	G2	11.2			
		R9A	11.2	G2	2	Select One
			34.3			
2. Assemble Bolt and Washer and Release						
Fixture		G1A	10.5	M9A		to Left Hand
			2.0	MfC		to Washer
			5.6	P1SE		Bolt to Washer
Washer to Hole		P1SE	5.6			
			16.2	AP1		Push thru Washer
		RL1	2.0	RL1		
			41.9			

Sheet Of

EXHIBIT III


CHICAGO LIGHTHOUSE FOR THE BLIND - 5 PC. COASTER SET
PERFORMANCE REPORT OF AVERAGE DAILY PRODUCTION
PERCENTAGE OF STANDARD
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
See Note (A)
Indicates Group Average
Indicates Test Individuals Average
Note (A) Production curtailed because of material shortage. Recorded production was for parts of days.
PRODUCTION DAYS
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
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21
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25
26

APPLICATION II

USING MTM STANDARD WORK ELEMENTS

Walter E. Eschen
Carr, Adams & Collier Co.
Dubuque, Iowa

COMPANY HISTORY AND BACKGROUND OF OUR INCENTIVE SYSTEM

In an effort to better understand our use of MTM Standard Work Elements, I think it might be of interest to briefly outline a little of our company's background. In 1866, Mr. William W. Carr gave up his job at Marshall Fields here in Chicago and, in partnership with a Mr. W. H. Austin, established the Carr-Austin Company in Dubuque, Iowa. This firm started with about 25 men, many of whom were skilled cabinet workers and carriage makers from Europe. They produced sash, doors, cabinets, church pews, bank counters, stair work, blinds, and mouldings made to order, no matter how special the design. From this small beginning our firm, now known as Carr, Adams & Collier Co., has grown to its present size. Most of the manufacturing is done in the Dubuque Plant which employs about 700 factory workers and about 100 office employees. In addition, we have eight Jobbing Branches and one kiln drying plant.

We compete with about 30 other stock woodwork manufacturers located in the Northwest, on the Mississippi, and in Wisconsin, as well as with about 3,000 smaller mills scattered throughout the nation. Our chief raw material is kiln-dried Ponderosa Pine. It is shipped to Dubuque from sawmills on the West Coast. The products we manufacture are distributed through jobbers throughout the 48 states. Our products consist of our own line of Doors, Windows, Frames and Cabinets, together with the same products made to customer order.

As can be readily understood, this problem of making part of our production to customer specification complicates our rate setting problems. While the company's long-range goal is towards a complete label line of its own products and while this has been done in the cabinet line, it will take time to accomplish in other parts of our line. Accordingly, we have given increasing attention to better means of developing and extending our standard data; and, in the process, have embarked on the use of MTM as an additional work measurement tool to be employed where it is advantageous to do so.

We feel that MTM with its emphasis on ways to improve methods will be very valuable to us in a large part of our rate setting work since, because wood machines fairly rapidly, a good part of the work cycle consists of handling time rather than machine time. It is, of course, in these manual parts of the cycle that the use of MTM applies.

We have an incentive system in effect throughout our plant. This system was started in 1930 and gradually expanded to cover the entire plant. Our plant is laid out on a product rather than a process basis. Because of this fact, we have similar machines in each of the major departments. The incentive was installed one department at a time and, while data was developed for each machine or process within a department, the coordinating of data for similar machines in different departments wasn't always carried out as completely as it would have been if all of the same type of machines in the entire plant were rated at the one time.

Our goal, therefore, in the establishing of Standard Data is to provide basic data applicable to similar machines or operations throughout the plant. The actual application of this data to incentive rates will, of necessity, take years to apply for in accord with our Union Contract, incentive rates are not changed unless methods are changed.

An important concept to adhere to in devising a system of this type is to make it flexible so that additions and changes may be made in the future.

Two of the most perplexing problems we encountered in attempting to set up our MTM Standard Data Program were:

1. Is there a way to design our basic elements so that they can be readily employed to build rates for not only all machines or operations of the same general type for which they are principally intended, but also for different types of machines or operations?

2. If we design these basic elements to meet the above requirements, how do we index them so that they can be easily located?

We found our answer in the help given us by Gene Smith of the A. T. Kearney organization. The system we are in the process of developing is based on the general principles developed by Gene and some of his associates. The specific application to our problems and the developing of our MTM data has been done in our organization by Eldon Smith ably assisted by Verne Mauer. The moral of this story is be sure there is a Smith around if you're thinking of getting into a Standard Data System.

USE OF MTM STANDARD WORK ELEMENTS

(a) MTM Standard Element Sheet (Exhibit I)

Before getting into the explanation of our exhibits, I would like to say that it has been approached with the intent of illustrating the principles upon which the system is founded, and details have been included only to the extent that they are needed, to illustrate the principles. Needless to say, several variations of this general system can be worked out to suit specific industries and plants.

In the upper left-hand corner of Exhibit I is shown the "MTM Standard Element" sheet. Exhibit II is an actual sample of this same form.

The paper is light enough in weight to be able to be used as an ozalid master copy. In order to strengthen the impressions on this form, we use an orange carbon paper with the carbon towards the back of the Element Sheet. While these element sheets could, of course, be typed if desired, we have not done so but retain them in their original form, usually lettered.

Only one element is written up on each page and the elements are purposely kept as short as possible to retain their ability to be used in a variety of different operations. In many cases, an element will consist of only three or four motions, and in very few cases should they exceed ten motions.

When an element sheet is completed, a sepia copy is run from the original copy. As shown on Exhibit I, the original is filed in the "Operation" Book II, and the sepia copy in the "Element" Book I.

We file this way since we have found that thus far at least we use the "Element" Book I the most and that by placing the sepia copy in this book we save wear on the original since it is in the "Operation" Book II, which is not as frequently used. In other words, file the sepia copy in the book that will be used the most.

This cross-filing feature is the heart of the system and makes it possible to look under a certain type of "Element" in Book I and find all data pertaining to that element developed from any operation throughout the plant. At the same time, it is possible to go to the "Operation" Book II and find all available data on any particular operation.

Should it be desired it is possible to run positive copies from any of these Standard Element Sheets to be placed in final rate write-ups for specific machines or operations.

In addition to the "MTM Standard Element" sheet, we use a "Summary" sheet form which is essentially a piece of graph paper. This is also a light weight paper capable of being run on ozalid and carries a file box in the upper right-hand corner the same as the "Standard Element" sheet. This form is used as a work sheet, or as a summary sheet, to combine information from the "Standard Element" sheets. It is filed like the "Standard Element" sheet except that it could appear in Books I and II and will appear in the "Summary" Book III. On the other hand, the "Standard Element" sheet ordinarily would appear in Books I and II only and not in the "Summary" Book III.

Our use of the "Summary" Book III is merely to provide a book which essentially contains answers only and, therefore, is easy to use.

Also, by this time, the data has been developed sufficiently so that it can be used by time study men who have not been trained in MTM.

(b) File No. Codes

In the center of Exhibit I and Exhibit III, the two file number codes are found.

The file number on the "Standard Element" sheets are from these codes and the elements are classified according to the area in which they are first developed and according to the predominant purpose of the element.

The first part of the three part file number is the four digit "Type of Operation" code. We have used four digits to have plenty of leeway in covering future operations which we may not be able to anticipate at this time.

The first two digits indicate the general type of operation and the second two digits the specific type of operation. For example, by referring to the "Operation" Code on page 23 under the heading "Bore" the number 04 refers to the general type of operation and the sub-numbers tie down the specific type of operation within the general classification. In other words, the code for a Single Vertical Boring Machine would be 0401.

As explained on Exhibits I and III, this "Operation" code is also used on the large or "Major" tabs of the divider sheets in the "Operation" Book II and in the "Summary" Book III. In both of these books the "Major" tabs contains the complete operation code which is four digits.

The second part of the three-part file number is the four digit "Element" code.

The make-up of this code is similar to that of the "Operation" code in that it consists of four digits, the first two digits being used to indicate the general type of element and the second two the specific type of element.

We have been able to foresee only 11 general categories for this code, but it is probable that as our work progresses we will expand that number.

This "Element" Code is also used on the tabs of the Divider Sheets in the "Element" Book I. Here the "Major" tabs carry the first two digits of the code and the "Major" tabs the second two digits.

The first two digits of the "Element" Code is also used on the "Minor" tabs of the "Operation" Book II.

The third part of the three-part file number is merely a sequence number which shows how many "Element" Sheets of the type indicated by the second part of the file number have been built up. This third-part code is built up consecutively as needed and is actually the one that ties down a specific page for reference purposes.

To summarize briefly, our means of tabbing our Books where the Standard Element and the Summary Sheets are filed as shown below.*

(c) Conclusion

We have had two people working on our Standard Data Program for about a year now and feel the work accomplished thus far has been very valuable.

We are making haste slowly and do considerable checking of our data with a TMU timer. These checks are filed as part of our data. We do this not only as a check on our MTM analysis but also to provide background as to the validity and soundness of our MTM data should it at some future time be contested by our Union.

While our long-range goal is to continue to develop all the MTM data we can, at the present we use MTM and Time Study elements in the same rate if it seems advantageous to do so.

We have made some changes in our plan since we started and undoubtedly will find it necessary to do so in the future. These changes however, have concerned minor details rather than the basic principles upon which the plan is founded.

It has been a pleasure to discuss our experiences with you and I hope some of you may find areas where some of these general principles may be of possible help to you in your own particular plants.

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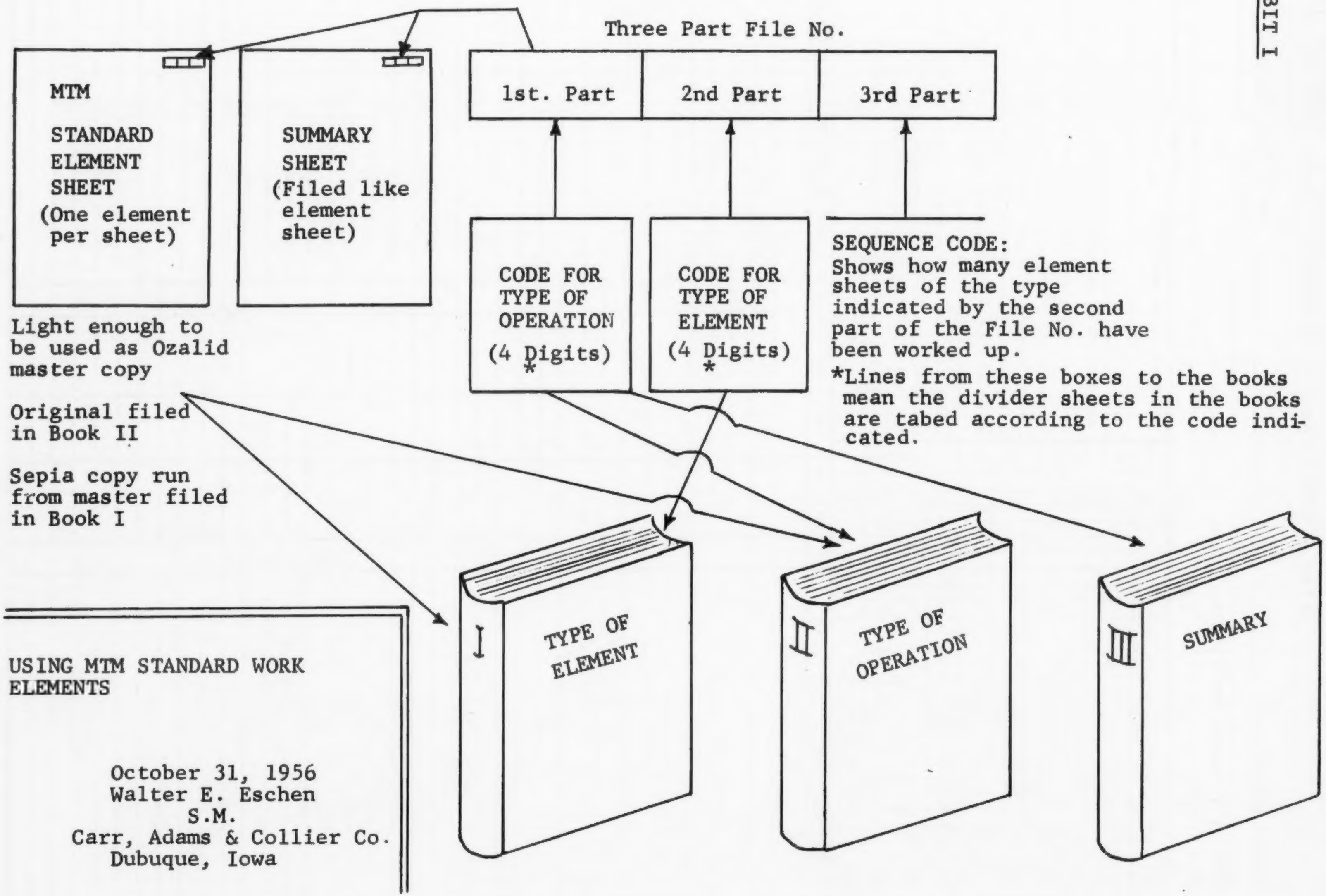
*

	Element Book I	Operation Book II	Summary Book III
Major Tab	1st 2 Digits of Element Code	1st 4 Digits of Operation Code	1st 4 Digits of Operation Code
Minor Tab	2nd 2 Digits of Element Code	1st 2 Digits of Element Code	None

EXHIBIT I

SUMMARY OF SYSTEM



MTM STANDARD ELEMENT FILE EXHIBIT II

ELEMENT DESCRIPTION ______________________ DATE ______________

______________________ ANALYST ______________

MATERIALS, TOOLS, EQUIP. ETC. ______________________

____

DESCRIPTION OF WORKPLACE ______________________

APPLICATION OF ELEMENT ______________________

DESCRIPTION - LEFT HAND	F	MOTION	TMU	MOTION	F	DESCRIPTION - RIGHT HAND

EXHIBIT III

CODE

EXCERPTS FROM CODE FOR TYPE OF OPERATION

04 BORE
- 01 Vertical - Single
- 02 Vertical - Multiple
- 03 Horizontal - Single
- 04 Horizontal - Multiple

06 BRANDER
- 01 Electric

08 CLAMP
- 01 Door
- 02 Sash, Screen or Screen Door-Spot Pin
- 03 Sash, Screen or Screen Door-Hand Pin
- 04 Rotary

10 COPER
- Single End

Used:

a. First part of three part file number on MTM Standard Element Sheets.

b. Complete code (4 Digits) used on "Major" tabs in "Operation" Book II and in "Summary" Book III.

EXCERPTS FROM CODE FOR TYPE OF ELEMENT

01 GET MATERIAL FROM
- 01 Truck
- 02 Floor or Pile
- 03 Machine
- 04 Conveyor
- 05 Bench or Table
- 06 Skid

02 DISPOSE OF MATERIAL TO
- 01 Truck
- 02 Floor
- 03 Machine
- 04 Conveyor
- 05 Bench or Table
- 06 Skid

03 ASSEMBLE PARTS WITH OTHER PARTS
- 01 Sash-Slotted Construction
- 02 Sash-Mortise Construction
- 03 Doors-Dowel Construction
- 04 Doors-Mortise Construction
- 05 Cut Stock

Used:

a. Second part of three part file number on MTM Standard Element Sheets.

b. On tabs in "Element" Book I. "Major" tabs show first two digits of code and "Minor" tabs show second two digits of code.

c. First two digits of code used on "Minor" tabs of "Operation" Book II.

APPLICATION III

METHODS IMPROVEMENTS FOR DIE CASTING

Rex Winchell
Clinton Machine Company
Clinton, Michigan

To give you a little background about myself and my company, I am the Director of Methods and Standards at the Clinton Division of the Clinton Machine Company and have been associated with them in this capacity since November, 1955. The Clinton Machine Company is one of the world's largest producers of gasoline air cooled engines. The Engine Division is located in Maquoketa, Iowa. At Clinton, Michigan, we have actually two divisions, the Chainsaw Division and the Die Cast Division.

The company formed and started producing its gasoline engines in 1946. In December of 1952 the company entered the chainsaw field and has also risen to one of the major producers of chainsaws. In December of 1953 the Die Cast Plant was started.

Our Die Cast Plant is known as a "captive" plant. By that it is meant that the castings produced are for use exclusively for Clinton Machine Company, either in our Engine Division at Maquoketa or Chainsaw Division in Clinton. Castings produced range all the way from the cylinder block of the engine to a small oil pump. Parts are cast from both aluminum and zinc alloy. Our Die Casting Plant started out in December of 1952 with one small used machine. Our present total today is 20 modern machines plus the trim room.

A statement as to what die casting is—it is the process of injecting hot molten metal into a die, under pressure. The die is water cooled which solidifies the metal, giving the resulting casting. The molten metal is ladled from a holding pot to the shot well of the machine.

WHAT CAUSED US TO GO TO MTM?

The system of setting standards, prior to our going to MTM, was the conventional stopwatch method. Due to conditions that had been creeping in through a period of time, inconsistencies in standards were prevalent and loose rates were common rather than rarity. After an audit of the studies it was evident what had happened and was happening—was:

1. Improper recording of elements at time of study.

2. Method in use at time of study not recorded and no record of work place layout.

3. Die changes that affected the standard were not kept current.

As a result, no methods improvements were picked up and gradually the standards became very loose and inconsistent. To put it plainly, all control had been lost.

What was wanted of course was to bring the standards up to date and develop a better control of methods improvements. The Maquoketa Division completed the MTM Application Course the first part of March. I made a trip to our Maquoketa plant to get their opinion of MTM. Actually, we had been talking with the A. T. Kearney & Company about such a course, and this trip convinced us to go ahead with the program without delay.

Our program was carried on on a two-day a week basis and we finished the course the middle of May of this year.

In our training program we not only trained the Time Study personnel, but also the key personnel from both of our Clinton divisions. Those trained were the Plant Superintendents from both Die Cast and Chainsaw, the Tool Room Foreman, and one Union representative. Before the program started, it was discussed at length with the Union Committee and they were in complete agreement. It was by mutual agreement that their representative took the course.

My view of "Methods Improvements" might be a little broader concept than some might think of "Methods Improvements." In my opinion, "Methods Improvement" is anything that will improve the use of <u>manpower</u> and equipment. With this in mind, we have been trying to get the full utilization of both manpower and machine. Some think of methods improvements as anything to do with the work place layout or in the ease of handling of parts. I will endeavor to show how other things can be definitely called methods improvements.

When we started with our first analysis, obviously questions were raised as to whether MTM

would work with some of the operations that had to be done, such as ladling of the hot molten metal from the holding pot to the shot well. The metal is molten and at about 1,175^{o}, and for that reason would the "C" move cover this?—We purchased a watch which reads directly in TMU and after the analysis was made, we checked all elements with the watch. We definitely found that these jobs could be analyzed with MTM.

Our first analysis was rather rough but definitely showed that our work place layout needed improvement. We were casting a cylinder block that has a steel liner. One of these liners is placed in the die before closing the die and making the shot. After making the shot, the operator returns his ladle to the holding pot, turns to the table and inspects the previous casting and waits for the machine to open. After the die opens, the casting is removed and placed on the table at the rear of the operator.

It was in this table that we noted that the improvement was needed. Previously a table was used that was (1) flat—(2) it was below the proper work height—(3) being a flat table, the operator had to move his piece aside the length of the table after inspecting. We designed a table that was proper operator height where the casting was placed after removal from the machine. (It might be noted here that the operator is working on a raised platform.) From the operator end, the table was sloped down toward the other end. This was to provide proper working height for those operators whose job it was to remove and stack the blocks on pallets.

By having the table constructed in this manner, the operator had just a short move down the incline to dispose of a finished block. The table also was designed to hold approximately an hour's run, thus eliminating delays in production because of a "table full of stock."

With our table now made and set in place, we proceeded to re-analyze the job. We, naturally, saw things as we progressed to improve our motion pattern and finally we were satisfied that we had the most desirable motion pattern and trained the operator this way.

We were well satisfied with our results. We not only had attained a substantial increase in production, but the work place was something that could be made standard for all machines. Our motion pattern also could become almost standard for almost every die cast part—except for some elements that change with the part. This motion pattern we knew would be standard for all cylinder blocks.

Our analysis then brought out the following:

1. A standard motion pattern:

2. A standard work place—which brings all steel liners, swabs and tools to proper working height.

3. Standardization of the way we greased our shot wells and sprayed our dies.

This brings us up to the point of getting our rate or pcs/hour. We formerly had a standard of 33 pieces per hour. Our new rate was 50 per hour, an increase of 51-1/2%.

The rate was put in and it did not take us long to find out we weren't going far. As I mentioned before, the die is cooled by water circulating through the die. We found that we could run a pace of 65 pieces per hour for a short period, but then our die was so hot we were running scrap pieces and pieces were sticking in the die. The one thing that was pointed out—<u>OUR WATER SUPPLY WAS INADEQUATE!</u>

At this point, it seemed we had two choices:

1. Lower the standard to a point where it could be run.

2. Go to top management with the facts, point out what the standard should be—all conditions being right—and try to get the water supply corrected.

The latter approach was taken. We took our case to management and, having the savings to be realized as a point of argument, we were able to convince management to go ahead and put in a new water supply.

We figured that savings to be realized from just the block jobs alone was $11,000 per year. The cost of improving the water supply—$6,500—or a $4,500 savings on the first job. With the adequate water supply, we could move ahead on the other jobs.

Other factors that an analysis such as this will point out is the die conditions which affect the amount of scrap produced.

By training personnel at the superintendent level, it is much easier to prove your case. Having received training in MTM, they appreciate the soundness and accuracy of an MTM analysis of a proposed method.

In summary, I have tried to show where we too often consider the improvement of the immediate work station, the handling of material, etc., as the only method improvement factor. I believe we should consider the improvement of anything that gives us <u>full</u> utilization of man and machines as a method improvement.

If we hadn't been able to get an adequate water supply, we wouldn't have gotten full utilization of man and machine.

If the die is faulty—causing excessive scrap and this condition is corrected so the die produces to accepted allowances—we again have achieved full utilization of man and machine.

These to me are just as much a method improvement as the changing of a work station to shorten a reach or raising a tote bin to eliminate a bend.

One caution in methods improvement—we can work on methods improvements to excess. Analyze carefully before going all out, and make the improvement pay for itself in a reasonable length of time.

NO METHODS IMPROVEMENT IS GOOD UNLESS YOU CAN UTILIZE IT!

APPLICATION IV

MTM IN NEEDLE TRADE

F. F. Langhans
S. H. Camp Company
Jackson, Michigan

From a paper presented at the Fifth International Conference

We have read from time to time pro's and con's on MTM, and frankly, we refuse to become excited. Indeed, we at Camp's are much too elated to devote valuable time to those who are debating the merits and value of MTM from the sidelines.

Although we at Camp's had been using time study for years prior to 1950 as a tool to determine methods and work standards, we recognized that time study has certain inherent drawbacks. These, of course, could be elaborated upon to a high degree, but for the sake of brevity, may be simply stated as follows: that existing time-study procedure do not enable one to engineer methods in advance or actual production, with the degree of accuracy enjoyed by the use of MTM.

Time study is an inherently subjective procedure depending upon the skill and judgment of the individual engineer. Realizing the limitations of time study, we at Camp's, decided back in 1949 to investigate various systems of work measurement, in the hopes of finding a procedure which would enable us to develop the most efficient methods and standards in advance of production, for the purpose of predetermining costs and manufacturing requirements.

METHODS—Time measurement was finally selected as the procedure which most closely approximated our complete requirements. It was understandable not only by the trained engineer we found, but also by the supervisors and to a great degree by the average operator. It was applicable not only to light, highly repetitive sewing operators, but to all operations associated with the products.

The application of MTM resulted in absolute consistency in standards. It proved quick and easy to apply.

Therefore, in January of 1950 we undertook the application of MTM to our operations and at the same time the most modern and up to date equipment was installed.

Our first applications of the new formula were cautious and were accompanied by close checks against past records of performances. However, as our experience in the application of these new formulas grew, we began to realize just how valuable a tool was created.

I don't wish to convey the impression that once the original formula was developed that all research stopped. Indeed, the formula is undergoing constant change and revision as new developments in sewing equipment are evolved.

You might, at this point, be wondering what value methods time measurement can be to you as a manufacturer or engineer.

Methods time measurement, as applied by the engineer, subjects each product considered to close analysis to determine the quickest and best method of performing each of the required operations. By accurate measurement, this procedure determines the standard hours required to perform a task and at the same time, provides a standard method for the operator to follow. If the prescribed method is followed, the operator should be able to meet and often surpass the standard.

Greater emphasis on method has resulted, in higher productivity and more effective work flow.

An example of the importance of method in the final determination of the total time necessary to perform an operation might be given by a consideration of the basic factors which affect each motion. For example: The time to make a certain reach motion will vary according to the location of the part. If the part of object reached for is alone in a fixed location, as in the case of the balance wheel on a sewing machine, the operator will develop an automaticity in reaching for this object. This means that she does not have to look in the direction she is reaching, nor gauge the distance reached. If, for instance, the part being reached for, is one or several, such as one of a group of labels located on a machine bed, it will be necessary for her to look in the direction in which she is reaching in order to make a selection of the label which is to be

grasped. The method employed in performing each reach is entirely different with a consequent difference in time.

One of the major problems in any needle trade factory is the development of effective methods in manufacturing garments. This development is generally done in a trial and error basis; frequently, when a new garment has been designed, a small quantity of garment parts, together with a sample of the new garment, is sent to the floor lady, who in turn, gives these garment components to the operators on the floor to be made up. The order and method in which the garment is manufactured is dependent upon existing operating conditions. Little consideration is given to attempt to sub-divide the work in order to attain some sort of balance for the necessary operations and consideration of the proper sequences of operations for smooth work flow through the factory, also, is ignored. This procedure often results in costly and inefficient manufacturing methods. Using MTM as a means of determining efficient methods, the engineer trained in its procedure is able to analyze thoroughly, each necessary operation to manufacture the garment and determine, not only the proper sequence of operation, but also the most effective and economical method of performing such operation. All of this may be done in advance of manufacturing, in order that sufficient preparation may be made by supervision to manufacture the product.

ESTABLISHING ACCURATE WORK STANDARDS

Once the method of manufacturing a garment has been established, the application of predetermined time value immediately establishes the time to perform these operations. In other words, each one of motions that we used to determine the method has a predetermined time value, and as soon as you list the motions necessary to perform the operation and record the values for each motion, you have the time standard. There are few operators who do not object to being timed by the use of a stop watch. Many operators feel as if they have been placed under a microscope where every move or action is being watched and being recorded with the result being used to their disadvantage. Operators also resent being classified as poor or subnormal as is often the case when studied. More important, time studies are taken on many operations with insufficient attention being paid by the engineer to the methods being used. This may result in standards that are inconsistent and where earnings are either too high or too low. When this occurs, confidence in the integrity of the time study engineer, and management as a whole is lessened. When a standard established for an operation is loose, the operator will slow down for her own protection, knowing that if her earnings go too high, the standard may be cut, and she may be forced to give the same production for less pay. When a standard is set too tight, the operator knows that she cannot make the standard and therefore is willing to collect the day rate for the operation while coasting along with a minimum of effort to produce. With confidence in the fundamental accuracy of the data, operators, when assigned to a new operation, proceed to do the work assigned to them in full confidence that the standards that have been set may be equaled or exceeded by exercise of conscientious skill and effort. As a result of this attitude, standard production on an operation is attained in the shortest possible time. This resulted in a decrease in make-up pay and an improvement in operator morale. I don't think that you can overemphasize the importance of attaining accurate work standards. This is important in all of the work we are called upon to do and not necessarily apply to industrial operators only. We all have certain standards for the work we perform. It is important that these standards be accurate, well gauged and that we understand just what these standards of performance are, in order that we may proceed in confidence that we are doing our jobs in the manner in which they should be performed.

The same situation applies to the operator working at a sewing machine. If she understands how the standards are set, if she believes in the fundamental accuracy of the standards, and knows the proper method, she will proceed to work to the best of her ability, thus exceeding the standards established. This will result in an increase in her earnings, an increase in production, and as a consequence attain a certain measure of satisfaction out of the work she is doing.

Method time measurement has also been of immeasurable value as a tool for estimating. Many of you in all probability, have been concerned one way or another, with the problem of determining which garments out of a number of proposed designs are to be put into actual production.

The decisions as to which garments will be rejected or accepted for production will be determined to a considerable degree by the estimate of probable manufacturing cost. If an estimate is too high, the garment may be rejected for manufacture because the retail price of the garment would limit its demand by a price cautious trade. On the other hand, if the estimate is too low, the garment may be accepted for manufacture. Subsequently, after the garment has reached the production floor, unanticipated production cost increases may result in either losing money on the garment, or increasing the retail price of the garment with a resultant falling off in sales.

The use of methods time measurement for estimating enables the estimating department to provide quick and accurate estimates of manufacturing costs. Further, the accuracy of these estimates, will point the way to slight savings in unnecessary material handling.

Many designers who are experts at designing a garment that meets the most exacting style and functional requirements, have little or no conception of production problems. As a result, the experienced engineer can readily suggest minor construction changes which, while reducing manufacturing costs, still retain the original styling and functional requirements. Some of the most common possibilities for improvement in design concern revision of seam construction, stitch requirements, seam curvature, materials and trimming.

Through the use of MTM, the engineer is able to compare the cost of manufacturing the garment as originally designed and the cost of the garment with the changes he would recommend. With this information, management can arrive at a sound decision as to the value of these changes. It frequently will happen that because of design changes, the engineer is able to reduce the manufacturing cost to such an extent that the garment will have a much greater market with a consequent increase in sales.

Garment construction changes may also simplify and reduce the time necessary to train operators to make the garment, thus increasing production and reducing training costs.

This procedure will also tend to make the designer methods conscious, with a consequent improvement in designs from a production standpoint.

When considering the purchase of new and important equipment, the use of MTM provides a means of evaluating machine effectiveness. This is done by an analysis of the time required to perform the operation with the old machine as compared with the time required to perform the same operation with a new machine. The important thing to remember is that this analysis can be made before any equipment is purchased. The use of MTM for this purpose enables one to accurately predetermine the total savings in dollars and cents and also the total time required to amortize the new equipment.

The methods time measurement procedure to establish work standards is gaining rapid favor among the rank and file of needle trades operators and their elected shop representatives.

The application of MTM formulas to establish standards and methods in a factory is never cloaked in mystery. Indeed, before embarking upon an engineering survey, meetings are held which all employees are invited to attend. During these meetings, the aims of the survey are explained to the employees. An explanation of how the MTM formulas are used to establish standards is also presented at these meetings. These meetings are followed by a question and answer period at which time, all questions regarding MTM, the manufacturing system and the piecework plan is explained.

These group meetings are sometimes supplemented with special meetings, attended by supervisors and elected employee representatives at which time, a more detailed explanation of the functioning of the MTM formulas are presented.

These sessions serve to provide the operators with an appreciation of the relationship of time and method.

Once the time standards established through the use of the MTM formulas have been used in actual production, the fundamental accuracy of the data is quickly established.

Whenever there is a question as to the validity of a standard, a check of the standard is made to establish whether a clerical error has been made. In no case, is there any question as to whether the master formulas are in error.

Perhaps the greatest value of the formulas lies in the fact that the formulas provide the key, whereby the specialized formulas may be constructed which are designed for specific types of products. These formulas enable consistent, accurate standards to be set on operations in a fraction of the time required to set standards by other methods.

In our operation we manufacture surgical supports for men and women, plus surgical appliances. Standards were established on over 4,000 operations for 250 products in a time of approximately 6 weeks after construction of our specialized formulas.

It might be noted that our savings resulting from the use of MTM exceeded 20% of our direct labor payroll. At the same time operator earnings increased to an average of 12% above previous earnings.

APPLICATION V

MTM AND ASSEMBLY

Jerome Goldman
Brookley Air Force Base
Mobile, Alabama

From a paper presented at the Fifth International Conference

When we completed the MTM Application Course at Brookley Air Force Base, we were taught to recognize, classify and record certain acts in terms of motions recognized by MTM. We learned too, that many motions are repetitive and that these repetitive motions could then be treated as separate industrial motions or sequences. The application of MTM and Assembly operations is not difficult, as long as we apply correct typical motion sequences and understand the theories of grasp, position and disengage.

Sometimes, we meet problems in Assembly that seem rather complex, but if we break down any operation into its motions, we will find that any motion can be identified and classified. Also, we must have self-confidence in our work. Many of us felt that we were unable and sometimes incompetent to use MTM, but as all of us found out, once we have taken the first step, our fear disappeared.

Each type of assembly work will have its own peculiarities and it is necessary for us to apply the MTM principles to our own product concerned. One thing that we must keep in mind, is that in order to establish a correct MTM Standard, we must:

1. Obtain complete information regarding task, equipment and method.

2. We must analyze, classify and record every necessary motion required to perform the job.

3. We must apply the principles of motion economy.

We were given an infinite number of examples of motions patterns, as it is possible to express many manual activities in terms of the basic motions recognized by MTM. Therefore, as we continue to work with MTM, new motion sequences become less and less frequent. When we are engaged in developing standards or methods improvements, we quickly learn to recognize the reoccurring motion patterns for a variety of jobs of the same general nature.

One of the most important advantages that we have found in MTM, has been its use in Methods improvement. These advantages we can divide into three (3) categories:

1. To the "Worker."
2. To the "Supervisor."
3. To "Higher Management."

As to the "worker," we have found that it assists him as follows:

1. To know what is expected.
2. To get credit for a job well done.
3. To obtain improved working conditions.
4. To feel more a part of the team.
5. By equalizing output expected.
6. By setting a reasonable goal to achieve.
7. By providing a basis for awards for suggestions.

To the "supervisor," it assists him as follows:

1. To know what is expected.
2. To receive recognition for a job well done.
3. To schedule work.
4. To explain manpower needs.
5. By providing a basis for evaluating the before and after of changes in procedures or equipment.
6. By providing basis for evaluating the before and after of instruction or training given.
7. By providing basis for comparison of efficiency in like operations.

In regard to "higher management," it helps them as follows:

1. To make a program and work commitments.
2. To schedule the use of manpower and facilities.
3. To determine, explain and evaluate personnel requirements.
4. To determine approximate unit costs.
5. To keep work load and personnel in balance.
6. To compare performance in comparable operations.

7. By indicating the areas in need of management studies.
8. By providing basis for checking results of action taken. (Command policy, work simplification, etc.)
9. By relating the personnel program to management needs.
10. By providing a basis for incentive awards.

Successful application of MTM and Assembly work is accomplished through team work of the concerned organizations. Such teams should consist of representatives from Production Control, Industrial Engineering, Inspection and other engineering departments. These production teams should meet regularly and the result will be an effective organization.

The team can spot possible difficulties and resolve problems harmoniously at the proper level. When these problems are solved at this level, then they prevent higher management from incurring any heavy loss of manpower and equipment.

MTM NEWS

Reprinted from the Flying Times, Kelly Air Force Base

Twenty-six Maintenance employes who recently completed the 105-hour Methods Time Measurement Course last week were presented with completion certificates.

Presentation was made by George Chane, who, along with Jim Bassage, was here to discuss final details of Project DEAR (Depot-level Evaluation of Accounting Requirements).

R. H. Van Horn, Maintenance deputy director, who invited Chane to present the certificates, said:

> "Presentation of certificates by Chane was significant because he and Bassage are credited with the introduction of methods Time Measurement into the Air Force Maintenance Engineering Management Program."

Chane spoke briefly to the group and extended his personal congratulations to each student for a splendid achievement. Stressing the importance of MTM toward the successful implementation of the Work Measurement and over-all Management program, he stated:

> "Your portion of work is one segment of the vast over-all Management Program which has been established in the interests of National Defense and economy. I feel privileged to have had a part in establishing the program with the Air Force, and it gives me great pleasure to see the work you people are doing."

Chane and Bassage saw, firsthand, the strides that have been made with MTM at Kelly. This important methods improvement and standard establishing technique is being widely used in the Accessories, Engine and Electronic branches.

Also, standard data and time formula derivation work (using MTM as back-up data) is being performed in Manufacture and Repair and Aircraft branches.

According to Clinton Brauer, Maintenance Industrial Engineering division deputy chief, this graduating class was the sixth to complete the MTM course since it was originally inaugurated at SAAMA in 1955.

The course is outlined in accordance with standards set up by the MTM Association for Standards and Research, and each student must pass a rigid Association examination before completion certificates are awarded.

Students receiving certificates were: Mrs. Norma Knapp, Mrs. Cora Kyser, E. J. Hoffman, J. Garza, O. G. Walters, Jr., J. W. Collins, A. P. Gilliland, D. Love, R. S. Ondarza, F. O. Kingery, Jr., G. O. Garcia, J. D. Hale, and E. G. Krezdorn.

Others were: F. Rodriguez, Jr., H. R. Thomas, C. E. Merkelz, E. H. Broline, M. R. Cannon, C. E. Karney, W. J. Denzer, R. H. Olson, D. M. Parchman, G. B. Steele, A. S. Vera, J. J. Voney and J. B. Penaloza.

26 MAINTENANCE EMPLOYEES COMPETE METHODS COURSE

ANNUAL MEETING

The Annual Meeting of the MTM Association is scheduled for February 6, 1957, Engineer's Club, New York City.

Election of Officers for the year 1957 will be conducted at this meeting.

CHAPTER NEWS

SOUTHERN CALIFORNIA CHAPTER

A panel discussion, entitled, How We Introduced MTM into Our Company, was conducted at the January 9 meeting. Lee Freeman, Program Chairman, issued the statement that "many industrial engineers who are acquainted with the advantages of MTM are associated with plants which either do not use MTM or do not apply it to the fullest extent possible. They must sell their individual management on the advantages of MTM before management will 'buy' a full-scale MTM program."

Don Wheeler, of Robertshaw-Fulton, Clayton Wood, of Johns-Manville, and Lee Freeman of Voit Rubber were the panel members presenting the "hows" and "whys" involved in "selling" an MTM Program.

Dr. Lillian Gilbreth, whose eminence and distinguished services in the field of Industrial Engineering need no introduction, will be the principal speaker at the January 30 meeting. This meeting is co-sponsored by the Orange County Chapter of the Society for the Advancement.

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RESEARCH REPORTS

R.R. 101 Disengage

This report contains a preliminary study of the element disengage. While it is still classified as tentative, the report contains some extremely interesting conclusions on the nature and theory of this element.

R.R. 102 Reading Operations

The first step in the use of MTM for establishing reading time standards is contained in this report. In addition, the report contains a synopsis of the work done in this field by 11 leading authorities.

R.R. 104 MTM Analysis of Performance Rating Systems

A talk presented at the SAM-ASME Time and Motion Study Conference, April 1952. It contains an analysis of performance rating systems and various performance Rating Films from an MTM standpoint.

R.R. 105 Simultaneous Motions

This report represents almost two man-years' work on a study of Simultaneous Motions. It is a final report of the Simultaneous Motions project undertaken by the MTM Association. While it does not purport to provide complete and exhaustive answers to all problems in the field of Simultaneous Motions, it presents a great deal of new and valuable information which should be of interest to every MTM practitioner.

R.R. 106 Short Reaches and Moves

This report contains an analysis of the characteristics of Reaches and Moves at very short distances. It develops important conclusions concerning the application of MTM to operations involving these short distance elements.

R.R. 107 A Research Methods Manual

The research activity of the Association has developed an effective and comprehensive set of methods for carrying on research in human motions. This report details the major techniques used. Adequate sources of motion data, film analysis, data recording, and statistical methods of analysis are among the topics discussed.

R.R. 108 A Study of Arm Movements Involving Weight

In this report, the results of a large investigation into the effect of weight on the performance times of arm movements are presented. While more effective means of determining correct time allowances for moving weights are given, the comprehensive discussion of the whole area of weight phenomena is probably of more fundamental importance. The effect of such conditions of performance as the use of one or two hands, sliding vs. spatial movements, and male and female performance are among the topics presented.

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